



## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification <sup>6</sup> : <b>A61F 2/44, A61B 17/70</b>	<b>A1</b>	(11) International Publication Number: <b>WO 97/00054</b> (43) International Publication Date: 3 January 1997 (03.01.97)
<p>(21) International Application Number: <b>PCT/SE96/00797</b></p> <p>(22) International Filing Date: 18 June 1996 (18.06.96)</p> <p>(30) Priority Data:  9502224-0 19 June 1995 (19.06.95) SE  9503191-0 14 September 1995 (14.09.95) SE</p> <p>(71)(72) Applicant and Inventor: <b>OLERUD, Sven [SE/SE]; Villa Malmen, S-740 11 Länna (SE).</b></p> <p>(74) Agent: <b>BLOMBERG &amp; CO., SKANDINAVISKA PATENT-BYRÅN AB; P.O. Box 14031, S-104 40 Stockholm (SE).</b></p>		<p>(81) Designated States: AL, AM, AT, AU, AZ, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IS, JP, KE, KG, KP, KR, KZ, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, US, UZ, VN, ARIPO patent (KE, LS, MW, SD, SZ, UG), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).</p> <p><b>Published</b>  <i>With international search report.</i>  <i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>  <i>In English translation (filed in Swedish).</i></p>
<p>(54) Title: <b>AN ADJUSTABLE SPACING DEVICE AND A METHOD OF ADJUSTING THE DISTANCE BETWEEN TWO VERTEBRAE WITH THE AID OF SAID SPACING DEVICE IN SPINAL SURGICAL OPERATIONS</b></p> <div data-bbox="454 1155 1201 1617"> </div> <p>(57) Abstract</p> <p>The present invention relates to an adjustable spacing device for insertion between vertebrae in spinal surgical operations to adjust the distance between two vertebrae where a fibrocartilage disc is located, wherein the device (1) comprises two mutually superposed elongated plates (2, 3), wherein the plates are provided centrally with a pivot which functions to prevent movement of the plates (2, 3) in the direction of their longitudinal axis but permits the plates (2, 3) to move angularly in relation to one another and at least one of the plates to move perpendicularly to the common plane of the plates (2, 3), wherein the distances at which the plates (2, 3) are spaced apart can be adjusted at each end, individually, with the aid of an adjuster means (7) having two spacing members (12, 14) disposed in a longitudinally extending cavity (6) defined by milled grooves (4, 5) which extend along that side of each plate which faces towards the other plate, and wherein the milled grooves (4, 5) correspond to one another so that together they can receive the adjusting means. The invention also relates to a method for adjusting the distance between two vertebrae with the aid of the spacing device in spinal surgical operations.</p>		

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AN ADJUSTABLE SPACING DEVICE AND A METHOD OF ADJUSTING THE  
DISTANCE BETWEEN TWO VERTEBRAE WITH THE AID OF SAID SPACING  
DEVICE IN SPINAL SURGICAL OPERATIONS

5      FIELD OF THE INVENTION

The present inventions relates to an adjustable spacing  
device for insertion between two mutually adjacent vertebrae  
in spinal surgical operations so as to adjust and increase  
10      the distance therebetween, wherein there is formed a space  
in which a fibrocartilage disc is located and which space has  
diminished as a result of a pathological change. The inven-  
tion also relates to a method for adjusting and increasing  
the distance between two vertebrae by means of the adjustable  
15      spacing device.

DESCRIPTION OF THE BACKGROUND ART

Many different solutions for increasing the distance between  
20      two vertebrae that has diminished as a result of a patholog-  
ical change are known to this particular art. An intermediate  
disc, a fibrocartilage disc, is normally located between  
adjacent vertebrae. This disc may degenerate as a result of  
a disease process or pathological change, therewith reducing  
25      the distance between the vertebrae. Such conditions are  
treated with the intention of restoring the distance between  
the vertebrae and of filling the resultant space with bone  
transplant so as to achieve bone healing, fusion, between the  
vertebrae and therewith establish normal vertebrae spacing  
30      and stability between the vertebrae.

One method of holding the vertebrae apart during a bone  
healing process is to replace part of the space with a fixed  
body of some kind or other, after the vertebrae have been  
35      indirectly brought to a normal position. Among other things,  
cortical bone has earlier been used in this regard. In later  
times, it has become usual to use "cages", i.e. hollow

implants of different constructions which are filled with cancellous bone, so as to hold the vertebrae apart and also stimulate bone healing between the vertebrae at the same time. All of these solutions involve the insertion of a body  
5 which is unable to adapt to the specific shape or configuration that is ideal with respect to the particular individual conditions that prevail from case to case.

#### SUMMARY OF THE INVENTION

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The object of the present invention is to eliminate the aforesaid drawbacks encountered in vertebrae surgical operations of the aforesaid kind and to provide an implant which can be inserted surgically in between the vertebrae and  
15 wherein the distance therebetween can be adjusted in place, at both ends, independently of one another, and therewith achieve ideal conditions, i.e. the healthy and natural distances between respective vertebrae at their front and rear parts, which are determined and decided by the different  
20 lengths of the ligaments (band structures that surround the vertebrae) and suitably tension the same. In order to be able to maintain normal forward curvature of the spine within the lumbar region, the distance between the rear part of the vertebra interspace shall be longer than the distance within  
25 the forward part.

This object is achieved with an adjustable spacing device which comprises two mutually superposed elongated plates, wherein the plates are provided centrally thereof with a  
30 pivot which prevents mutual longitudinal movement of the plates but allows the plates to be positioned angularly in relation to one another and permits at least one of the plates to move at right angles to the common plane of said plates, wherein the distance of one plate from the other can  
35 be adjusted at each end, individually, by means of an adjuster having spacing means and disposed in a longitudinally extending cavity defined by mutually corresponding

5 cylindrical grooves milled in respective mutually facing  
surfaces of said plates, wherein said cavity also includes  
two circular recesses which extend obliquely from the short  
ends of the implant and in towards the centre thereof,  
10 wherein the deeper ends of the circular recesses either face  
away from each other and towards the short ends of the  
implant, and the shallower parts face towards each other in  
the centre of the implant, or one or both of the deeper ends  
are disposed in towards the centre on each side of a hole in  
15 the implant plates, said hole extending essentially at right  
angles to the longitudinal axis of the cavity.

The invention also relates to a method for surgically  
adjusting the distance between two mutually adjacent verte-  
15 brae with the aid of an inventive spacing device, wherein one  
or more spacing devices are inserted into the space between  
two vertebrae, whereafter the person making the insertion  
adjusts from one side the distance between the two plates in  
one spacing device, by first adjusting from one and the same  
20 side the position of the most distal end of the implant, by  
moving a thickened end-part of the adjuster into the cavity  
and towards the centre or out towards the end-part of the  
implant, and thereafter adjusting the end of the implant  
lying most proximal to said person, by moving a second  
25 thickened end-part of the adjuster in towards the centre of  
the implant or out towards said end-part, wherewith both  
parts are moved away from each other to therewith separate  
the two vertebra as a result of the varying depth of the  
cavity. The cavities thus formed by the side of and within  
30 the implant are then filled with an appropriate bone trans-  
plant material for subsequent bone healing between the  
vertebrae.

#### BRIEF DESCRIPTION OF THE ACCOMPANYING DRAWINGS

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Fig. 1 is a perspective view of the implant seen obliquely  
from above.

Fig. 2a is a side view of one of the plates.

Fig. 2b is a sectional view of the plate taken on the line A-A in Figure 2a.

Fig. 3a shows one of the plates from above.

5 Fig. 3b is a sectional view of the plate in Figure 3a taken on the line B-B in Figure 3a.

Fig. 3c is a sectional view of the plate shown in Figure 3b, taken on the line C-C in Figure 3a.

10 Fig. 4 is a side view of an adjuster, seen without a centre pin.

Fig. 5 is an end view of the adjuster screw.

Fig. 6 is a side view of the centre pin.

Fig. 7 shows an assembled implant with the adjuster adjusted differently forwards and backwards as seen in a longitudinal sectional view in Figure 1 from one side.

15 Fig. 8 illustrates another embodiment of the invention and shows the implant when assembled and the adjuster adjusted differently forwards and backwards as seen in a longitudinal view in Figure 1 from one side.

#### DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT OF THE INVENTION

25 The drawings show the main parts of an inventive spacing device. As evident from Figure 1, the spacing device 1 includes two elongated plates 2, 3 each having an obliquely milled groove 4, 5, said grooves together forming a cavity 6 in which an adjuster means 7 is received. An oval hole 8 is provided centrally of each plate and receives a centre pin 9 (see Figures 4-6) which is threaded on the adjuster means 7 and provided with flanges 10 whose diameter is larger than the smaller diameter of the oval hole 8 but smaller than the larger diameter of said hole, to provide a releasable connection for the two plates 2, 3. The plates can be manipulated with the aid of a wrench, key or like tool such that when fitting the implant 1 the upper plate 2 will be

positioned above the lower plate, by first placing the upper plate at an angle of  $90^\circ$  in relation to the longitudinal axis of the lower plate 3 and then rotating said upper plate so that in use said plate will be parallel with the lower plate 3.

The adjuster means 7 is comprised of a threaded rod 11 on which the centre pin 9 is screwed to a position roughly in the centre of the threaded rod 11. The rod 11 has a frusto-conical part 12 formed integrally with one end thereof and is provided with tool-coacting surfaces 13 on its other end. A frustoconical nut 14 is screwed over the tool-coacting surfaces 13 on the rod 11.

Figures 2a-3c illustrate the design of the plates. The plates 2, 3 of the implant 1 are mutually identical. The plates 2, 3 are provided with two oblique, cylindrical recesses 15, 16, e.g. milled recesses, one at each end, and a coaxially extending semi-circular groove 17 which extends in two opposite directions from the oval hole 8 in the centre of the plates 2, 3, out towards the deeper end of the semi-cylindrical recesses 15, 16 through a distance corresponding roughly to half the length of the semi-cylindrical recesses 15, 16 and with a slightly larger than the diameter of the threaded rod 11.

Figure 7 illustrates the mutual relationship of the plates 2, 3 when manipulating the adjuster means 7. The reference  $h$  illustrates the height of the implant 1 at one end and the distance between the vertebrae at this end when using the implant in a spinal surgical operation, whereas the reference  $H$  indicates the height of the implant 1 at its other end, i.e. the distance between the vertebrae at said other end.

Figure 8 illustrates the mutual relationship of the plates 2, 3 when the adjuster means 7 is manipulated. The reference  $h$  indicates the height of the implant 1 at one end thereof,

i.e. the distance between the vertebrae at this end, and the reference H indicates the height of the implant at the other end, i.e. the distance between the vertebrae at said other end. The adjuster means 7 is comprised of a threaded rod 11 onto which the centre rod 9 is screwed to a position roughly in the centre of the rod 11. One end of the rod 11 has formed integrally therewith a frustoconical part 12 whose wider end faces inwards towards the centre of the implant, and the other end of the rod is provided with means for coaction with a wrench, key or like turning tool.

The plates 2, 3 of the implant 1 are mutually identical. The longitudinally extending cavity 6 includes an oblique, cylindrical recess 15, 16 milled in each end of the plates 2, 3, of which recesses 15, 16 the first recess 15 has a deeper part which extends in towards the centre of the plates and a shallower part which extends towards the shorter ends of the plates (2, 3), whereas the other cylindrical recess 16 has a deeper part which extends towards the shorter ends of the plates (2, 3) and a shallower part which extends in towards the centre of the plates. Provided in the centre of the implant is a coaxial semi-circular groove 17 which extends in two mutually opposite directions from the oval hole 8 in the centre of the plates 2, 3 outwardly towards the end parts through a distance corresponding roughly to half the length of the recesses 15, 16 and which has a diameter that is slightly larger than the diameter of the threaded rod 11.

An inventive adjustable spacing device is used in spinal surgery in the following manner:

The adjustable spacing device is preferably used in pairs, one on each side of the space between two mutually adjacent vertebrae. The spacer device is inserted in between the vertebrae and the distance h between the rear parts of the implant plates 2, 3 is adjusted with the aid of a tool



inserted into the tool-coacting part 13 through a centre hole in the frustoconical part 14. The frustoconical part formed integral with the threaded rod 11 is caused to move in the cavity 6 in response to turning of the tool, by virtue of the centre pin 9 being screwed onto the rod 11 and also by virtue of the centre pin 9 being locked in the centre hole 8 of the plates 2, 3 and therewith prevented from moving in the longitudinal direction of the rod. The plates, however, are able to move perpendicularly to the longitudinal axis of the rod, i.e. the longitudinally extending sides can be moved in relation to each other so as to enable lh and LH to be varied, therewith enabling flexible adjustment of the distance between the vertebrae.

The distance between the front parts of respective plates 2, 3 is then adjusted by screwing-in the frustoconical nut 14 on the threaded rod 11 so as to be moved either into or out of the circular cavity 6 in the implant, therewith either increasing or decreasing the distance H between the front ends of the plates. The cavity thus formed by the side of and within the implant is then filled with an appropriate bone transplant for subsequent bone healing between the vertebrae. There is thus obtained in this way a natural, adjustable and flexible spacing between two mutually adjacent vertebrae with the aid of a readily adjusted implant, the ease in which the implant can be adjusted being due to the possibility of adjusting the implant from one direction. Movement of the plates in relation to one another with regard to the distance at which they are spaced apart at both the short ends and the long sides of the plates enables the spinal vertebrae to be brought to a natural position in a surgical operation.

It will be understood that the invention can be modified in many ways within the scope of the following Claims. For instance, the implant plates can be mutually connected in a number of different ways, for instance by means of a spring device or the like disposed around the plates.

## CLAIMS

1. An adjustable spacing device for application between vertebrae in spinal surgical operations for the purpose of adjusting the distance between two vertebrae when a fibrocartilage disc located therebetween has diminished as a result of a pathological change, characterized in that the device (1) is comprised of two mutually superposed elongated plates (2, 3), wherein the plates are provided centrally with a pivot means which while preventing movement of the plates (2, 3) in the direction of their longitudinal axes permits the plates (2, 3) to be angled in relation to one another and at least one of the plates (2, 3) to move perpendicularly to the common plane of said plates, wherein the device further includes an adjuster means (7) for adjustment of the distance between the mutually opposing ends of said plates (2, 3), wherein the adjuster means (7) has two spacing members (12, 14) disposed in a longitudinally extending cavity (6) defined by milled grooves (4, 5) that extend along that side of each plate that faces the other plate, and wherein the milled grooves (4, 5) correspond to one another for accommodation of the adjuster means.
2. A device according to Claim 1, characterized in that the longitudinally extending cavity (6) includes an oblique cylindrical recess (15, 16) milled in each end of the plates (2, 3), wherein the recesses (15, 16) have a shallow part which faces towards the centre of the plates and a deeper part which faces towards the shorter ends of said plates (2, 3).
3. A device according to Claim 1, characterized in that the longitudinally extending cavity (6) includes an oblique cylindrical recess (15, 16) milled in each end of the plate (2, 3), wherein one of these two recesses (15, 16), the first recess, has a deeper part which faces in towards the centre of the plates (2, 3) and a shallower part which faces towards

the shorter ends of the plates (2, 3), whereas the other cylindrical recess has a deeper part which faces towards the shorter ends of the plates (2, 3) and a shallower part which faces in towards the centre of the plates.

5

4. A device according to Claim 1, characterized in that the longitudinally extending cavity (6) includes an oblique cylindrical recess (15, 16) milled in each end of the plates (2, 3), wherein the cylindrical recesses (15, 16) have a shallower part which faces away from the centre of the plates and towards the shorter ends of said plates (2, 3), and a deeper part which faces in towards the centre of the implant.

5. A device according to Claims 1-4, characterized in that the adjuster means (7) is comprised of an elongated screw (11) having formed integrally therewith at one end a conical part (12) which forms one (12) of said spacer members; in that the pivot (9) is comprised of a centre pin (9) screwed onto the screw; and in that the screw (11) has a wrench or key engaging part (13) at the other end and a conical nut (14) which is screwed onto said other end and which forms the second (14) spacing member.

6. A device according to any one of the preceding Claims, characterized by a semi-circular milled groove (17) for receiving and guiding the screw (11), wherein the semi-circular groove (17) extends coaxially with the two cylindrical recesses (15, 16) from the centre of the plates (2, 3) and slightly outwards in the two recesses (15, 16).

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7. A device according to Claims 1-4, characterized in that the centre pin (9) has a diameter which fits a central hole (8) provided in each of the plates (2, 3).

8. A device according to Claim 7, characterized in that the central hole (8) in said plates has an oval shape.

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9. A device according to Claim 8, characterized in that the centre pin (9) has at each end a flange (10) whose diameter exceeds the small diameter of the oval central hole in the plates (2, 3).

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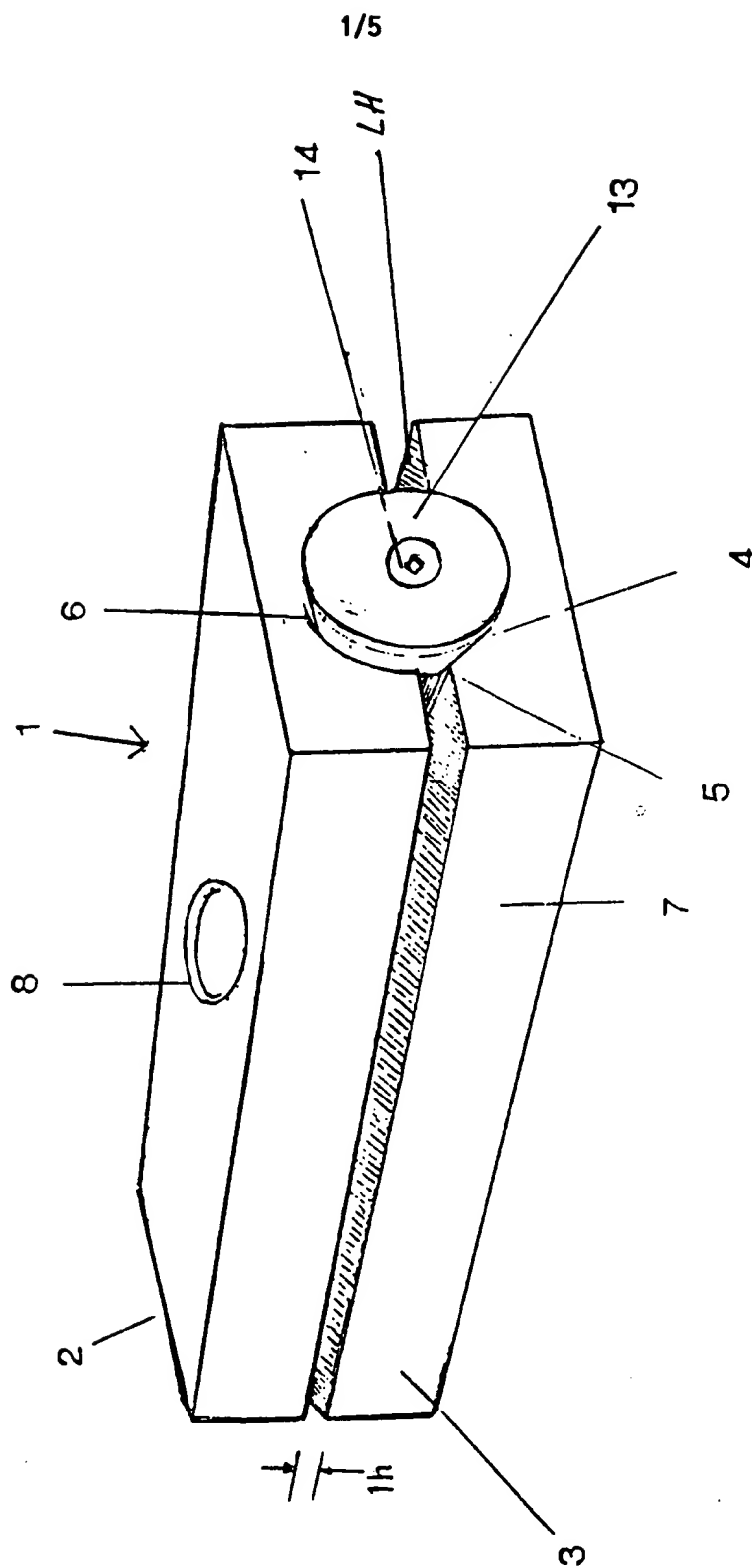
10. A method of adjusting the distance between two mutually adjacent vertebrae with the aid of a spacing device in accordance with Claim 1, characterized by inserting one or more spacing devices into the space between two mutually adjacent vertebrae and thereafter adjusting the distance between the two plates of a spacing device from one side by first adjusting the most distal end of the implant from one and the same side by moving a thickened end-part in the adjuster means in the cavity in towards the centre of the implant or out towards its end-part, and thereafter adjusting the end of the implant most proximal to the person making the adjustment, by moving a second thickened end-part of the adjuster means in towards the centre of the implant or out towards the end-part, therewith moving the plates apart and separating the two vertebrae through a distance which is adjustable and individually adapted to the front and rear ends of the vertebrae and differently for each pair of vertebrae to be treated by virtue of the oblique circular grooves of the cavity in both of said plates, and thereafter filling the cavity formed on one side of and within the implant with an appropriate bone transplant material for subsequent bone healing between the vertebrae and the implant.

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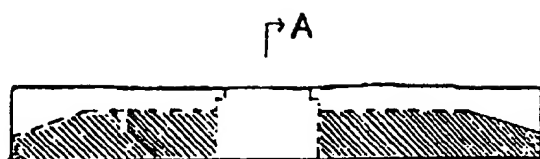
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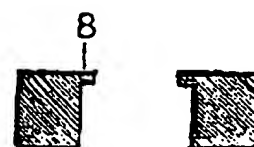
**Fig 1**

# SUBSTITUTE SHEET

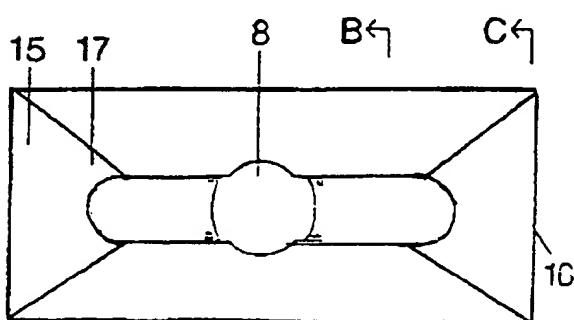
2/5



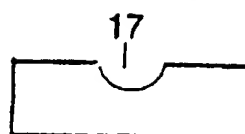
**Fig 2a**



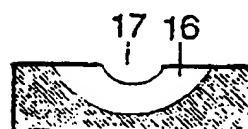
**2b** A-A



**Fig 3a**



**3b** B-B



**3c** C-C

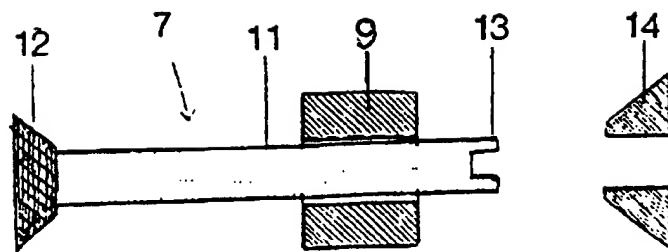


Fig 4

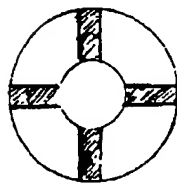


Fig 5

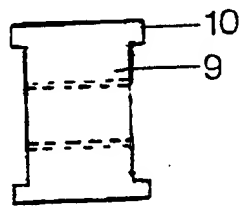


Fig 6

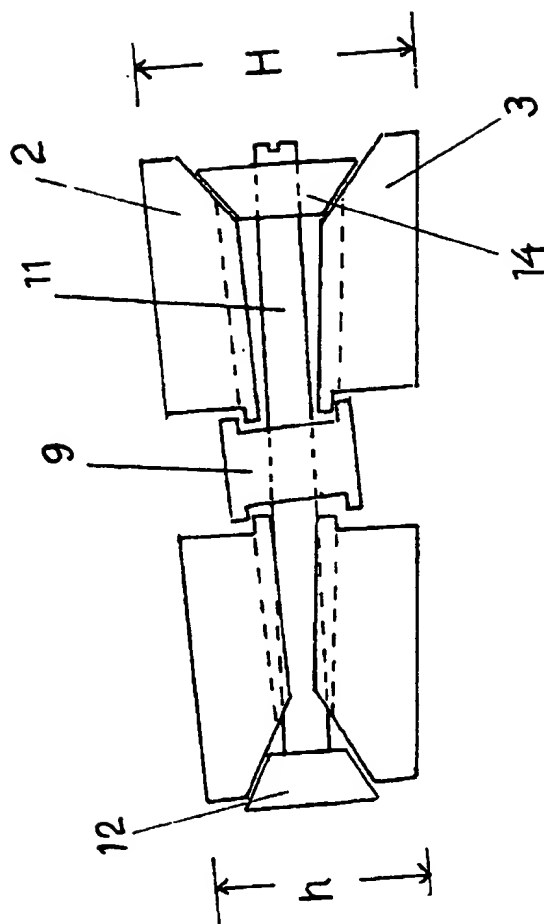


Fig 7



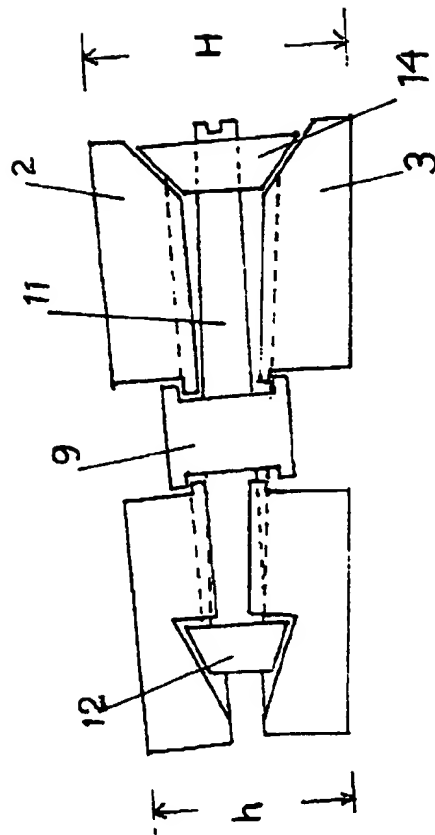


Fig 8

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 96/00797

## A. CLASSIFICATION OF SUBJECT MATTER

IPC6: A61F 2/44, A61B 17/70

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: A61B, A61F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

QUESTEL 2

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,A	WO 95/31158 A1 (TAYLOR, JEAN), 23 November 1995 (23.11.95), figures 1-3 --	1,5
A	WO 94/04100 A1 (SOCIETE DE FABRICATION DE MATERIEL ORTHOPEDIQUE-SOFAMOR ET AL), 3 March 1994 (03.03.94), figure 3 --	1
A	EP 0260044 A1 (SHEPPERD, JOHN A.N.), 16 March 1988 (16.03.88), figures 3-5 --	1-4,6
A	DE 4213771 C1 (GRUNDEI, HANS), 30 Sept 1993 (30.09.93), figures 1-2, abstract -- -----	1-4,7

☐ Further documents are listed in the continuation of Box C.
 ☒ See patent family annex.

\* Special categories of cited documents:

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
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Date of the actual completion of the international search

Date of mailing of the international search report

28 October 1996

30-10-1996

Name and mailing address of the ISA:  
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# INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 96 /00797

## Box I Observations where certain claims were found unsearchable (Continuation of Item 1 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☒ Claims Nos.: 10  
because they relate to subject matter not required to be searched by this Authority, namely:  
  
Methods for treatment of the human or animal body by surgery or therapy (PCT, Rule 39.1(iv))
2. ☐ Claims Nos.:  
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box II Observations where unity of invention is lacking (Continuation of Item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.  
☐ No protest accompanied the payment of additional search fees.

**INTERNATIONAL SEARCH REPORT**

Information on patent family members

01/10/96

International application No.

PCT/SE 96/00797

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO-A1- 95/31158	23/11/95	NONE	
WO-A1- 94/04100	03/03/94	NONE	
EP-A1- 0260044	16/03/88	JP-A- 63145650 US-A- 4863476	17/06/88 05/09/89
DE-C1- 4213771	30/09/93	NONE	